The Agriculturists 11(1): 76-81 (2013) ISSN 2304-7321 (Online), ISSN 1729-5211 (Print)
A Scientific Journal of Krishi Foundation ***Indexed Journal***

Effect of Nitrogen on the Growth and Yield of Carrot (*Daucus carota* L.)

M. Moniruzzaman, M. H. Akand, M. I. Hossain, M. D. Sarkar* and A. Ullah

Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh

**Corresponding author and Email: dulalsau_121@yahoo.com*

Received: 28 November 2012 Accepted: 18 May 2013

Abstract

An experiment was carried out at farmer's field in Debigonj, Panchagorh during November 2009 to February 2010 to evaluate the effect of four levels of applied nitrogen on the growth and yield of carrot. The experiment was laid out in a Randomized Complete Block Design with three replications. The maximum plant height (47.36 cm), root length (16.17 cm), fresh weight of leaves (145.1 g), dry matter content (11.66 g) of leaves, fresh weight of root (68.33 g), dry matter content of root (15.90%), gross yield (22.55 t/ha) and marketable yield (20.67 t/ha) were found in 100 kg N/ha.

Keywords: **Carrot, nitrogen, growth, yield**

1. Introduction

Carrot (*Daucus carota* L.) is a winter crop and is one of the important root vegetable crops cultivated throughout the world. Its fleshy edible roots are used as human food and animal feed (Salunkhe and Kadam, 1998). Carrot is rich in beta-carotene and is an excellent source of iron, calcium, phosphorus, and folic acid and vitamin B. It is also rich in sugar content (Yawalker, 1992) and some important medicinal values (Sadhu, 1993). It is used as salad and as cooked vegetable in soups, stews, curries, etc. and is also used for the preparation of pickles, jam, and sweet dishes (Kabir *et al.*, 2000).

In Bangladesh, carrot is cultivated on about 846 ha and production is 6350 t with an average yield of 7.51 t/ha (BBS, 2007). Comparatively, the yield of carrot in our country is very low. There are several factors which influence the yield and quality of seed. Among these optimum plant spacing, floral set, planting material, nutrition, health of mother plant, root size and root age etc. are very important.

Carrot demand for additional nitrogen fertilizer varies between 0-110 kg/ha (Salo, 1996; Warncke, 1996; Raynal-Lacroix, 1994). Nitrogen application above 110 kg/ha decreases the yield (Bishop, 1973) and quality due to root cracking (Balvoll, 1995). Large nitrate concentration in soil tends to improve shoot: root ratio (Raynal-Lacroix, 1994). Great variation in nitrogen uptake may be related to different climatic conditions, soil type, nutrient concentration, and well-developed root system which enable the plants to absorb nitrogen efficiently from the soil (Warncke, 1996). About 85 - 90% of nitrogen is absorbed by carrot during the growth stage of plant; while in the first and last quarter of its growth only 10 -15% of nitrogen is absorbed (Raynal- Lacroix, 1994). Split applications of fertilizers, especially nitrogen, improve carrot yield (Balvoll, 1995). This practice may result in high nitrate concentration at the harvest stage of carrots (Raynal-Lacroix, 1994). Increasing nitrogen would increase nitrate content in carrot roots (Shuval and Gruener, 1997; Mirvish, 1997). However, there is not much work on this issue in Bangladesh. The present research was

therefore, undertaken to determine the optimum rate of nitrogen for the better growth and yield of carrot.

2. Materials and methods

2.1. Experimental site, soil and season

The experiment was conducted at Debigonj farmer's field under the supervision of The Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka during November 2009 to February, 2010. The experimental area is situated in sub-tropical climatic zone as characterized by heavy rainfall during the months of April to September and scanty rainfall during the rest period of the year (Anonymous, 1960). The soil was mostly high land, sandy with low water holding capacity and erodible type having a pH value of 5.9.

2.2. Layout, treatments and design of the experiment

The single factor experiment was laid out in a Randomized Complete Block Design with three replications. The whole experimental area was 8.5 m × 8.0 m, which was divided into three blocks. Each block was again divided into 4 plots and hence there were 12 (4×3) unit plots. The size of unit plot was 2.0 m × 1.5 m. The distance between two adjacent blocks and plots were 1.0 m and 0.5 m, respectively. The experiment consisted of four levels of nitrogen viz., N_0 = Control, N_1= 70 kg N/ha, N_2= 100 kg N/ha and N_3= 130 kg N/ha. The treatments were assigned randomly in each block separately.

2.3. Seed rate, soaking and treatment

Carrot seeds of variety 'New Caroda' were soaked into water for 12 hours and then wrapped with a piece of thin cloth prior to sowing. Then they were spread over polythene sheet for two hours to dry. The seeds were treated with Vitavex-200 @ 3 g/100 g seed. Seeds were used at a rate of 3 Kg/ha as narrated by Rashid (1993), consequently 20 g of seeds were used for the experimental area. Seven, six and five shallow furrows were made for spacing of 20 cm × 15 cm with 1.5 cm depth in each plot for sowing seeds. Seeds were sown on 25 November, 2009.

2.4. Manure and fertilizers and Intercultural operations

Only urea, triple superphosphate (125 kg ha^{-1}) and muriate of potash (175 kg ha^{-1}) were used as the sources of nitrogen, phosphorus and potassium, respectively. Moreover, well-decomposed cowdung at 12 t ha^{-1} was applied to the field. The total amount of cowdung and triple superphosphate and 50% of total dose of urea and muriate of potash were applied during land preparation. The rest amount of urea and muriate of potash were applied after 35 days of seed sowing. Intercultural operations likes thinning, weeding, irrigation, insects and pest management were done as and when necessary to facilitate optimum crop growth.

2.5. Collection of data and statistical analysis

Data on plant height, number of leaves per plant, length of root, diameter of root and yield contributing characters were recorded from ten selected plants. The recorded data on different parameters were statistically analyzed with the help of MSTAT-C Program. The treatments mean were separated by Least Significant Difference (LSD) at 5% level of significance for interpretation of the result.

3. Results and discussion

3.1. Plant height

Application of different levels of nitrogen significantly influenced plant height at 45, 60, 75 and 90 days after sowing (DAS). Plant height increased gradually with the increasing levels of N application (Figure 1). At 60 DAS, the tallest (39.87 cm) plants were found in N_3 and shortest (32.76 cm) plants were obtained from N_0, which was statistically similar to N_1 (35.49 cm). At 75 DAS, also similar trend was observed. At 90

DAS, the tallest (47.36 cm) plants were found from N_3 and shortest (44.76 cm) plants were obtained from N_1, which was statistically similar to N_0 (44.89 cm). This may be due to over dose of fertilizers during growth. These results agree with the finding of Maurya and Goswami (1985).

3.2. Number of leaves per plant

Application of nitrogen significantly influenced the number of leaves of carrot at all stage except 45 DAS (Table 1). At 45 DAS, the highest (5.10) number of leaves was counted from N_2 and the lowest (4.19) was obtained from N_0. At 60, 75 and 90 DAS, the highest number of leaves (8.07, 9.27 and 11.61) was found in N_3 and the lowest (7.02, 8.40 and 9.60) was obtained from N_0. It might be due to the higher level of N application which increased the plants height and ultimately the leaf number.

3.3. Length and diameter of root per plant

The length of root of carrot was significantly influenced due to the application of different levels of nitrogen (Table 2). The highest root length (17.19 cm) per plant was found in N_2 which was statistically similar to N_1 (17.12 cm) and N_3 (16.70 cm) and the lowest root length (15.39 cm) was recorded in N_0. The root length gradually increased with increasing level of nitrogen. Sarker (1999) also found similar results.

Root diameter increased with increasing N level up to a certain level and then decreased (Table 2). The highest diameter of root (10.40 cm) was found in N_2 and the lowest diameter of root (6.90 cm) was found from N_0. Sarker (1999) and Batra and Kallo (1990) also found similar results.

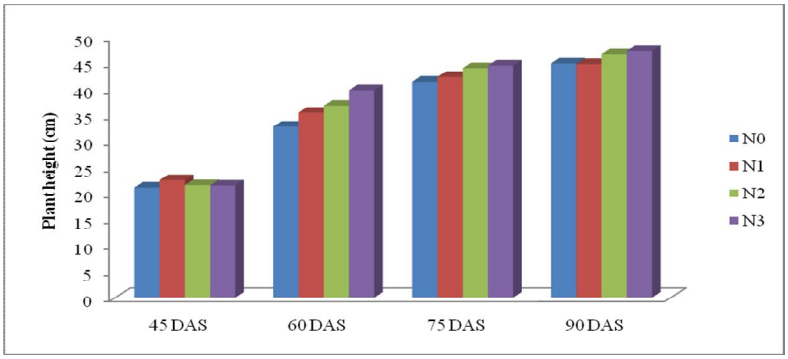

Fig. 1. Effect of nitrogen on plant height of carrot at different days after sowing (N_0 = Control, N_1= 70 kg N/ha, N_2= 100 kg N/ha and N_3= 130 kg N/ha)

Table 1. Effect of nitrogen on number of leaves per plant of carrot

Treatments	Number of leaves per plant at			
	45 DAS	60 DAS	75 DAS	90 DAS
N_0 = Control	4.19	7.02	8.40	9.60
N_1= 70 kg N/ha	4.60	7.90	8.60	10.10
N_2= 100 kg N/ha	5.10	7.60	8.80	10.30
N_3= 130 kg N/ha	4.50	8.07	9.27	11.61
LSD $_{(0.05)}$	1.34	0.9903	1.075	1.782
CV %	17.04	7.56	7.10	10.07

3.4. Fresh weight and dry matter content of leaves

Significant variation was found in respect of weight of fresh leaves due to application of different levels of nitrogen (Table 2). The maximum fresh weight of leaves (145.10 g) was found in the plants grown at the N_3 while the minimum (128.50 g) was in control.

Dry matter content of leaves varied from 8.55 to 11.66%. The N_3 treatment gave the maximum dry matter content of leaves (11.66%) and the minimum dry matter content of leaves (8.55%) was found in N_0 (Table 2).

3.5. Fresh weight and dry matter content of roots

Different doses of applied N influenced on fresh weight of root significantly. The fresh weight of root increased with increasing N level up to a certain level and then decreased (Table 2). The maximum fresh weight of root (68.33 g) was obtained from N_2 while the minimum (38.33 g) was obtained from control. Abdel Razik and El-Haris (1997) also reported similar results in carrot.

The maximum dry matter content of root (15.90%) was obtained from N_2 while the minimum dry matter content of root (9.87%) was obtained in control treatment (Table 2).

3.6. Percentage of cracked and branched root

The percentage of cracked root varied significantly due to the application of different levels of N (Table 2). The maximum percentage of cracked root (3.17%) was in the treatment of N_3 while the minimum (2.05%) in N_2.

The mean value of branched root (%) varied significantly due to the application of four levels of nitrogen (Table 2). The maximum percentage of branched root (6.92%) was in N_3 and the minimum percentage of branched root (5.84%) was in N_0 which is similar to N_1.

3.7. *Gross yield of root*

Significant variation was found in respect of gross yield of root due to different levels of nitrogen. The gross yield of root increased with increasing N up to a certain level and the decreased (Table 2). The maximum gross yield of root (22.55 t/ha) was found from the treatment of N_2 while the minimum (12.65 t/ha) in N_0. Sarker (1999) showed that nitrogen treatments significantly increased yield of carrot per hectare.

Table 2. Effect of nitrogen on the growth and yield of carrot

Treatment	Length of root (cm)	Diameter of root (cm)	Fresh weight of leaves (g/ plant)	Fresh weight of root (g/plant)	Dry matter content of root (%)	Dry matter content of leaves (%)	Gross yield (t ha^{-1})	Cracked root (%)	Branched root (%)	Marketable yield (t ha^{-1})
N_0 = Control	15.39	6.90	128.50	38.33	9.87	8.55	12.65	2.64	5.84	11.58
N_1= 70 kg N/ha	17.12	9.26	135.50	51.00	14.18	9.61	16.83	2.26	6.04	15.46
N_2= 100 kg N/ha	17.19	10.40	145.10	68.33	15.90	11.66	22.55	2.05	6.23	20.67
N_3= 130 kg N/ha	16.70	8.99	136.90	65.33	13.88	9.47	21.56	3.17	6.92	19.39
LSD $_{(0.05)}$	1.031	0.674	14.87	8.141	1.429	0.8346	1.668	0.002	0.5301	2.636
CV %	6.35	7.75	11.14	8.62	10.86	8.71	5.35	8.93	8.66	9.28

3.8. Marketable yield of root

Significant variation was found in respect of marketable yield of root by different levels of nitrogen. The marketable yield of root increased with increasing N up to a certain level and then decreased (Table 2). The maximum marketable yield of root (20.67 t/ha) was found from the treatment of N_2 while the minimum was in N_0 (11.58 t/ha). Patil and Gill (1981) stated that the yield depended on the quantity of nitrogen fertilizer and it was the highest when 300 kg of nitrogen per hectare was applied.

4. Conclusions

Nitrogen had significant influence on the growth and yield of carrot. The tallest plants (47.36 cm), highest number of leaves (11.61), highest root length (16.17 cm), maximum fresh weight of leaves (145.1 g), maximum dry matter content of leaves (11.66%), maximum dry matter content of root (15.90%), maximum fresh weight of root (68.33 g), maximum gross yield of root (22.55 t/ha) and maximum marketable yield of root (20.67 ton/ha) were found in 100 kg N per ha. Therefore, from the present study it may be concluded that, 100 kg N per ha were suitable for optimum growth and yield of carrot. Further study may be conducted in different agro-ecological zones of Bangladesh under variable field condition to confirm the result of the present experiment before recommending it to the grower

References

Abdel Razik, A. K. and El-Haris. 1997. Effect of nitrogen fertilizer levels and gebberelic acid concentration on carrot yield in sandy soils. *Alexandria J. Agril. Res.* 41 (2): 379-388.

Anonymous, 1960. Soil Survey Report of Sadar Sub-Division in the District of Mynensingh. Agric. Chem. Section. Deptt. of Agric. Govt. of East Pakistan.Bull. No. 6.

Balvoll, G. 1995. Grnsakdyrkning pa friland. Landbruksforlaget, Oslo, Norway.

Batra, B. R. and Kallo. 1990. Effect of different levels of irrigation and fertilization on growth and yield of carrot for root production. *Vegetables Sci.* 17 (2): 127-139.

BBS. 2007. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics. Ministry of Planning. Govt. of the People's Republic of Bangladesh.

Bishop, R. F. 1973. Effects of Nitrogen, Phosphorous and Potassium on Yields and Nutrient Levels in Carrots Grown on Sphagnum Peat and Mineral Soils. *Communication in Soil Sci. Plant Anal*. 4 (6): 455-474.

Kabir, J., Sen, H., Bhattacharya, N., Panda, P. K. and Bose, T. K. 2000. Production technology of vegetable crops. In: Tropical Horticulture (vol. 2, ed.). Eds. T. K. Bose, J. Kabir, P. Das and P. P. Joy. Naya Prokash, Calcutta, India. pp. 72-240.

Maurya, K. R. and Goswami, R. K. 1985. Effects of NPK fertilizers on growth, yield and quality of carrot. *Prog. Hort.*, 17 (3):212-217.

Mirvish, S. S. 1997. N-nitroso Compounds, Nitrite and Nitrate: Possible Implications for the Causation of Human Cancer. *Prog. Water Tech*, 8: 195-207.

Patil, B. D and Gill, A. S. 1981. Response of fodder carrot to N.P.K. fertilization. *Indian J. Agron.* 26 (2):203-204.

Rashid, M. M. 1993. "Shabjir Chash"(in Bangla). Published by Begum Shahla Rashid. BARI Residential Area, Joydebpur, Gazipur, Dhaka. p. 173.

Raynal-Lacroix, C. 1994. Nitrogen Nutrition of Carrots. Proceedings of the Third Congress of the European Society for Agronomy, Padova, Italy, 616-617.

Sadhu, M. K. 1993. Root Crops. In. Vegetable Crops (2nd ed.). Eds. T. K. Bose, M. G. Som and J. Kabir. Naya Prokash, Calcutta, India. pp. 470-578.

Salo, T. 1996. Nitrogen Budget in Cabbage, Carrot and Onion Production. NJF-utredning/rapport nr, 114: 22-27.

Salunkhe D. K. and Kadam, D. D. 1998. Handbook of Vegetable Science and Technology. Marcel Dekker, Inc. New York.

Sarker, M. N. 1999. Effect of nitrogen, phosphorus and potash on the yield of carrot. M.Sc. thesis, Dept. of Hort. BAU, Mymensingh, Bangladesh.

Shuval, H. I. and Gruener, N. 1997. Infant Methemolobinemia and Other Health Effects of Nitrates in Drinking Water. *Prog. Water Tech*, 8: 183-193.

Warncke, D. D. 1996. Soil and Plant Tissue Testing for Nitrogen Management in Carrots. *Communication in Soil Sci. Anal.*, 27: 597-605.

Yawalker, K. S. 1992. Vegetable Crops of India (4th ed.). Agri-Horticultural Publishing House, Nagpur, India. p. 68.